# Greenbank Electronics

ISBUS 1.1 Reprinted February 1981

'ISBUS' Price £11.50 + handling charge + VAT

## 1. Historical Note

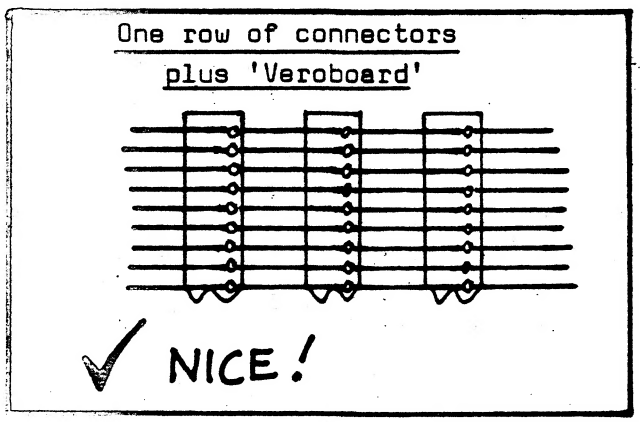
For some time we have been supplying a range of computer boards of the international card size (203x114mm), this being the widest standard card specified for the '3U' high 19" racks, which are extensively available both new and second-hand.

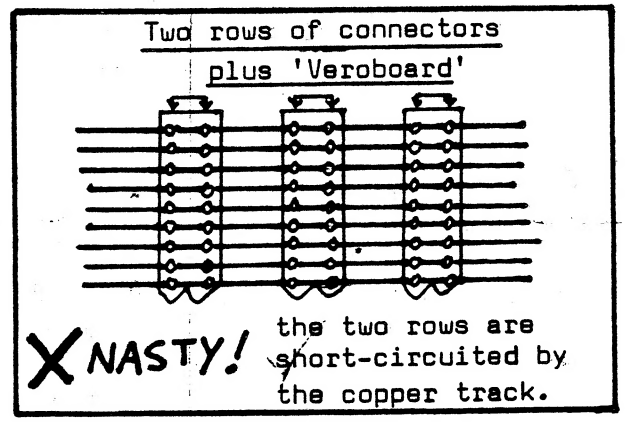
## 2. Good as Gold

The design and range of computer boards has been chosen to be as 'cost-effective' as possible. For this reason the standard 43-way sided edge connector on 0-1" pitch (less position 37 for polarisation) was chosen. Naturally the price of gold being what it is, alternatives were seriously considered but in the end gold plated contacts were chosen, (on the basis that although low-price has a high priority, high-reliability has to come higher).

## 3. The 'Veroboard' Connection

The two part 64-way connector, commonly used on the 160x100mm 'Eurocard', has a lot to recommend it (except its price!) but we originally rejected it because it is made up of two rows of contacts. When it comes to wiring up all the sockets 'Veroboard' is very cheap and satisfactory but can only be used easily for single rows of contacts. A picture is worth a thousand words (i.e. 1K to us computer buffs), so here's about 2K's worth:




## 4. Don't Miss the Bus

Of course, it does benefit a supplier normally to make it impossible for you to use 'Veroboard', because Veroboard's good and cheap and so he doesn't make so much MONEY. It's much more profitable (except for the customer) to force him to have a special board to serve the purpose of the 'Veroboard' in the simple example above. The special board has to be given a special name, - after all who'd want to own up to his friends and say 'My computer's made of 'Veroboard'! No, it's much more 'up-market' to say it's full of 'back-board' 'mother and daughter board', 'how's your father board', 'how's your back-board', 'back-plane', 'S-100bus', 'E78-bus', unibus, silly bus, no.14 Corporation Bus and so on.

92, New Chester Road, New Ferry, Wirral, Merseyside. L62 5AG Tel: 051-645 3391.

We don't want to be left out of the business of supplying back-boards just because 'Veroboard' will do instead, and our own bus is called ISBUS.

5. By Popular Demand : Isbus!

It is therefore clear that the world is waiting for our own, our very own: ISBUS - 1.1. Thus this bus ISBUS, is a no fuss bus.

The actual design of a back-board for a computer can be plain or fancy. Our own design is : plain. A 'fancy' bus is one which has features which double its appeal and triple its price.

6. Plain or Fancy

Although in theory a set of fancy features are a sine qua non ('sine qua non'= 'essential', for those of us who don't speak computer language), in practice they often represent a superfluosity. The features we have in mind are such items as multilayer boards, ground planes, impedance matching components, interleaved earth/signal lines etc.
We ourselves are very keen on single sided back-board:

1. It doesn't require plated through holes.
2. No tracks are hidden where they can't be seen. Trouble shooting open or short circuits on the bus no longer requires laser beams and x-ray vision.
3. Should you ever require to remove an edge connector (for example to cash in for its scrap gold content) it is not so hard as when plated-through holes have been used. (It still isn't easy - it's just not hard).

7. Where There's a Will There's a 86-Way

As all of our existing computer cards have a gold-plated edge connector on one side only, (regardless of whether or not the board itself has a single or double sided copper track) it might at first be thought sensible for us to provide a back-board simply for single sided 43-way sockets, a sort of rich man's 0.1" pitch Veroboard.
But wait a minute: how about the competition? We with a 43-way single sided connector and the young upstarts with their two rows of 32, making 64! There's only one way to beat them lads - we'll have <u>two</u> rows of connectors as well (2x43=86) - we'll see your 64-ways and raise you 22 (We were always a firm with winning ways).
So it came to pass that the back-board was laid out to suit either the single sided 43-way connectors or the double sided 86-way connectors, or indeed any mixture of the two.

8. Any Way You Want It

Our range of computer boards are based on the single-sided 43-way connector. The ROM and RAM boards, and Prom programmer board have proved very popular with people who want to graft them on to Alien (i.e. 'non-Greenbank') systems

e.g. Nascom,Pet, Apple,MK14, etc.etc., and the ISBUS-1.1 can be used with single sided 43-way connectors to interconnect these boards. (To force these cards onto a parallel bus structure some small modifications are required see Appendix 1 on page 13.)

Another group of people use our computer cards in conjunction with special purpose cards of their own design. At one end of the scale they are making small dedicated systems for a serious commercial application, at the other the amateur enthusiast is making giant umpteen-K, multiprocessor machines just for the fun of it.

Ah! How many times have we heard the phrase 'if only there were some spare bus lines I could use'? (Well we never have actually, but your're allowed a bit of a poetic licence when you're writing a leaflet like this).
For people like this the ISBUS can be fitted with double sided 86-way version of the 43-way connector. The extra ways can be used for separate purposes, or they can be blended into the existing address & data buses to make say 32-bit wide words (Definition wide words: what comes out of big mouths!).
We can supply a 'breadboard' card with the 86-way connector, and a number of these can be mixed with some (or none) of our existing computer cards, but it's not compulsary.

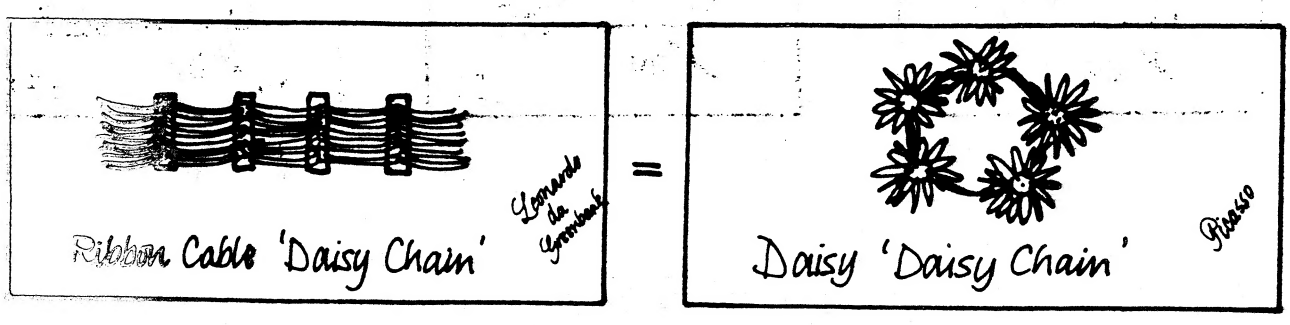
9. <u>I Want to be Like You</u>

It would be marvellous world if there were no individuals, and everybody was the same shape and size with the same thoughts, and we were all reduced to a nameless number working off a single 5V supply. Such bliss it would be if all computers were the same and 'Any card could plug in any Slot'.
In our effort to bring a little drabness into our otherwise colourful lives we have drawn up a list of suggested bus allocations for ISBUS. (See sections 14,15 page 6). One or two lines (virtually the whole of the 'B' side for example) have not yet been brought to the fold, but in subsequent issues of this leaflet, more and more will be rationalised and ratified until we achieve our ultimate purpose :

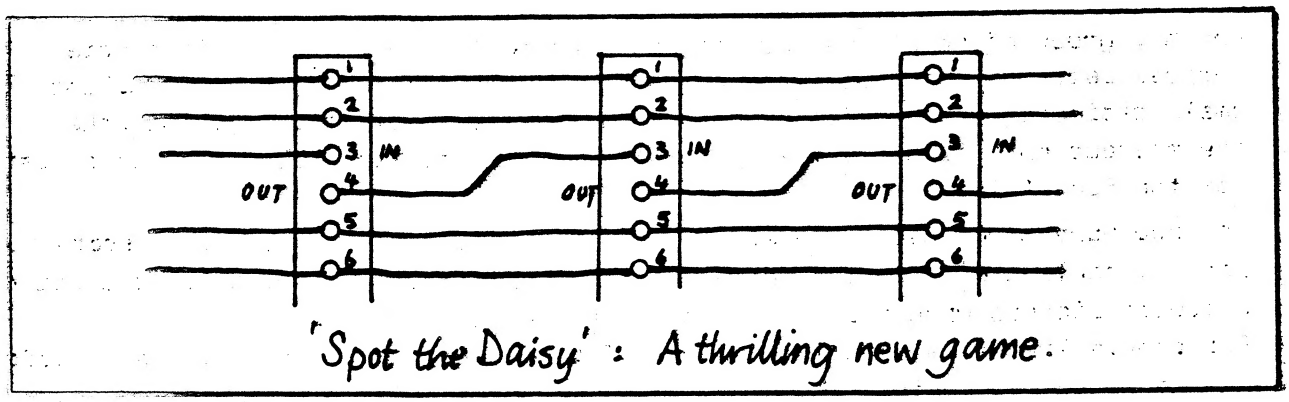
"Any card in any Slot"

10. <u>Daisy, Daisy, Give Me Your Data Do.</u>

There are two kinds of bus lines (bus lines are like tram lines, only different) we will consider: Parallel and Daisy-chain.
The term Daisy-chain needs defining, one use is common in referring to daisy-chained ribbon cable connectors :



The similarity is supposed to be obvious, but the connection shown as a ribbon cable daisy chain (where all similar contacts are connected together) we are going to call 'parallel'. Perhaps the following diagram will make it clear (the last one certainly didn't).




Lines 1,2,5,6 are 'parallel' and the line marked '3' is what we call a 'daisy-chain'.

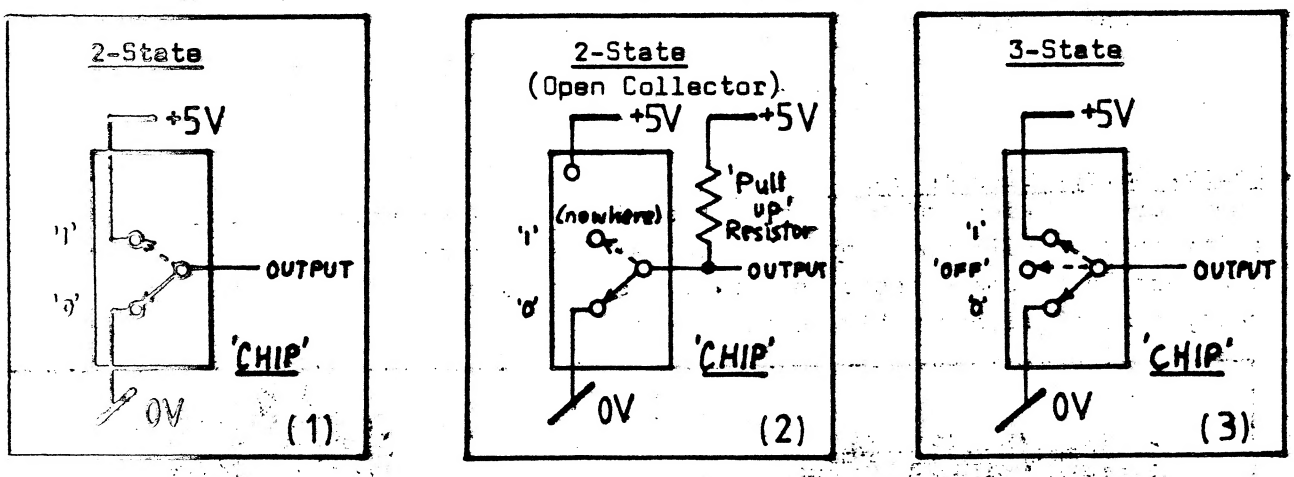
11. Section 11: What is a Daisy Chain Used For?

Don't ask me, I just saw it in a book!

12. When They Are Up They Are Up and When They Are Down They Are Down.

There are two main sorts of signal which can be allowed on our magnificent ISBUS, provided they have official permission: '3-state' and 'open-collector' (We might let ordinary logic (binary, 2-state) signals on later, if we're in a good mood).

Being suspicious of 'chips' (with good reason too, soon they'll be taking over our job), we will describe these signals as if they were produced by switches.



A computer bus generally has various outputs tied together, generally on purpose, and the fun begins when the various outputs are different. In case (1) there is an enormous explosion, in case (2) the 'low' outputs win (ohm sweet ohm), and case (3) there is another enormous explosion, unless by some happy chance the 3-position switch in every case but one is in the 'off' position, (which they usually are). It's a wonder more computers don't get in a state.

Now if they'd have asked us, we'd have said all the lines should've been open-collector (sometimes called 'wired-or'), but they didn't, and working on the principle why use 2-state logic when 3 will do, most of the bus lines these days are 3-state, except for some obstinate lines that just won't convert easily.

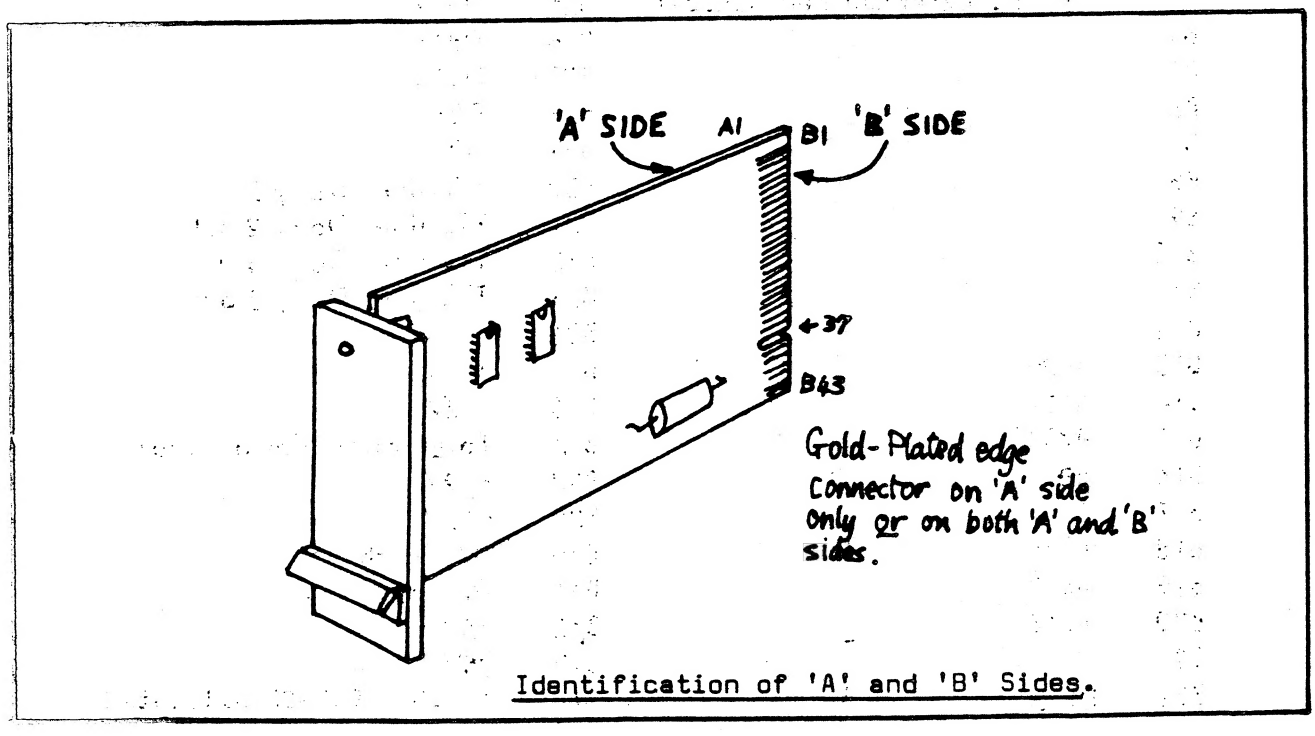
13. The Dawn of a New Age of Reason

Brothers remember our motto: 'Any card in and slot' !

We want a nice, clean, tidy world and so have drawn up the nice,clean,tidy table below.

There are still numerous computer boards in the world (our own included) which deviate markedly from the ideal. We will try a policy of friendly persuasion at first, but if future boards continue to be out of line we will stamp on them heavily, at least it will save the Post Office doing it. (HO! HO! - only a joke Mr. Postman).

The pins are numbered A1 - A43 on one side, and B1 - B43 on the other side. Single sided connectors have only 'A' contacts, and no 'B' contacts. The 'B' side is the same side as that on which the components are mounted:




Identification of 'A' and 'B' Sides.

14. 'A' Side ISBUS Preliminary Allocations.

Issue 2 5/7/80
Issue 3 8/9/80

| | | | |
|---|---|---|---|
| A1 | NI/O REQ | A23 | DB6 |
| A2 | NMREQ | A24 | DB5 |
| A3 | NWDS | A25 | DB4 |
| A4 | NRDS | A26 | DB3 |
| A5 | AB15 | A27 | DB2 |
| A6 | AB14 | A28 | DB1 |
| A7 | AB13 | A29 | DB0 |
| A8 | AB12 | A30 | NENIN (TTL line, Daisy 1 in) |
| A9 | AB11 | A31 | NENOUT (TTL line, Daisy 1 out) |
| A10 | AB10 | A32 | NRFSH |
| A11 | AB9 | A33 | RCLK (e.g. Z80 Ø) |
| A12 | AB8 | A34 | NWAIT (Open Collector line) |
| A13 | AB7 | A35 | +12V |
| A14 | AB6 | A36 | +12V |
| A15 | AB5 | A37 | Polarisation Slot (If used) |
| A16 | AB4 | A38 | -12V |
| A17 | AB3 | A39 | -12V |
| A18 | AB2 | A40 | 0V, Earth |
| A19 | AB1 | A41 | 0V, Earth |
| A20 | AB0 | A42 | +5V |
| A21 | NRST (Open Collector line) | A43 | +5V |
| A22 | DB7 | | |

Revn A: July 1980: A32, A33 allocated to now suit new 'Kemitron' range boards

15. 'B' Side ISBUS Preliminary Allocations.

| | | | |
|---|---|---|---|
| B1 | NI/O I/O Disable (o/c) | B23 | DB14 |
| B2 | NMD Memory Disable (O/C) | B24 | DB13 |
| B3 | NEMREQ Extended Mem Request | B25 | DB12 |
| B4 | | B26 | DB11 |
| B5 | | B27 | DB10 |
| B6 | | B28 | DB9 |
| B7 | | B29 | DB8 |
| B8 | | B30 | TTL line, Daisy 2 in |
| B9 | | B31 | TTL line, Daisy 2 out |
| B10 | | B32 | TTL line, Daisy 3 in |
| B11 | | B33 | TTL line, Daisy 3 out |
| B12 | | B34 | |
| B13 | AB23 | B35 | +12V |
| B14 | AB22 | B36 | +12V |
| B15 | AB21 | B37 | Polarisation Slot (if used) |
| B16 | AB20 | B38 | -12V |
| B17 | AB19 | B39 | -12V |
| B18 | AB18 | B40 | 0V, Earth |
| B19 | AB17 | B41 | 0V, Earth |
| B20 | AB16 | B42 | +5V |
| B21 | | B43 | +5V |
| B22 | DB15 | | |

Revn B: Sept 1980 B13-20 allocated

16. Does This Mean You've Deserted Me?

What, Greenbank desert an old and valued customer? - Never! As you can see, as far as possible the new ISBUS allocations are based on those implicit in the existing range of computer boards, and thus future new boards will be compatible with those existing at the moment.
The ISBUS has been standardised only to suit those who require standardisation. For example pins A30 and A31 being 'daisy' lines, are easily separated from the bus to give individual termination points for say the useful flag lines or sense lines of SC/MP.

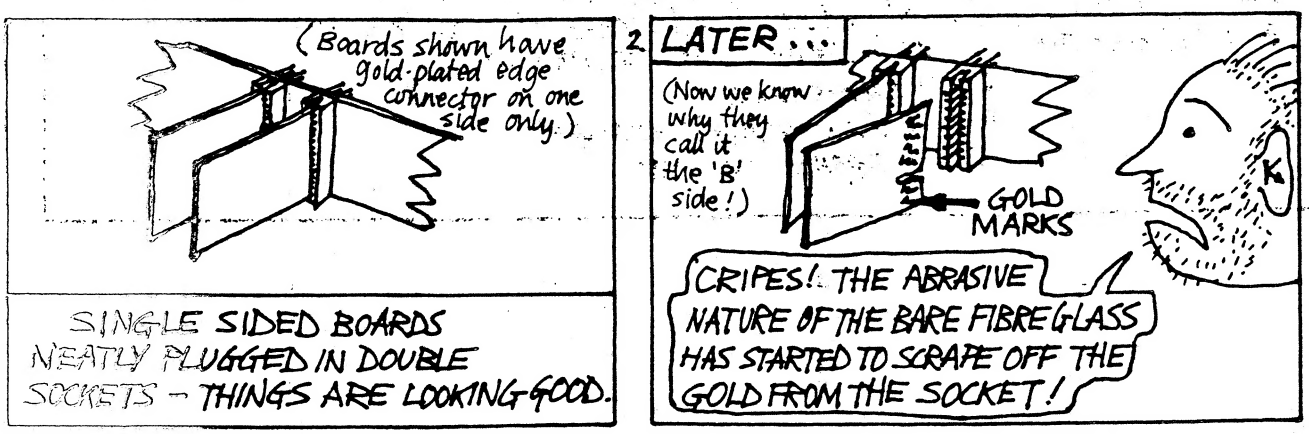
A21, A22, A33, and A34 are all for signals which are not present on previous boards. There is nothing to prevent these being re-allocated to suit your own special needs.

17. New Boys Report Here

What if it's all new to you - if you are a potential user of the existing boards, what should you do?
One method is to use non - ISBUS techniques i.e. 0.1" Veroboard for address and data busses, 18 swg wire for the power rail and point to point wiring (soldered or wire wrapped) for those boards which have special non-bus connections (e.g. VDU A,B,G and to a lesser extent DCR-6). - If flag & sense lines or non-standard supplies are to be used point to point wiring is best used here. The beauty of this method is flexibility, you can easily change and modify to keep yourself up to date as new things come along...
Alternatively you can use ISBUS for most of the cards, and modify the cards to conform to the rigidity of the designated allocations. There's no disputing that the use of the printed circuit backboard makes for a very neat and tidy job. (It would be virtually impossible to force VDU A,B,G, and DCR-6 onto the ISBUS board so they would be best grouped at one end, off the ISBUS board).

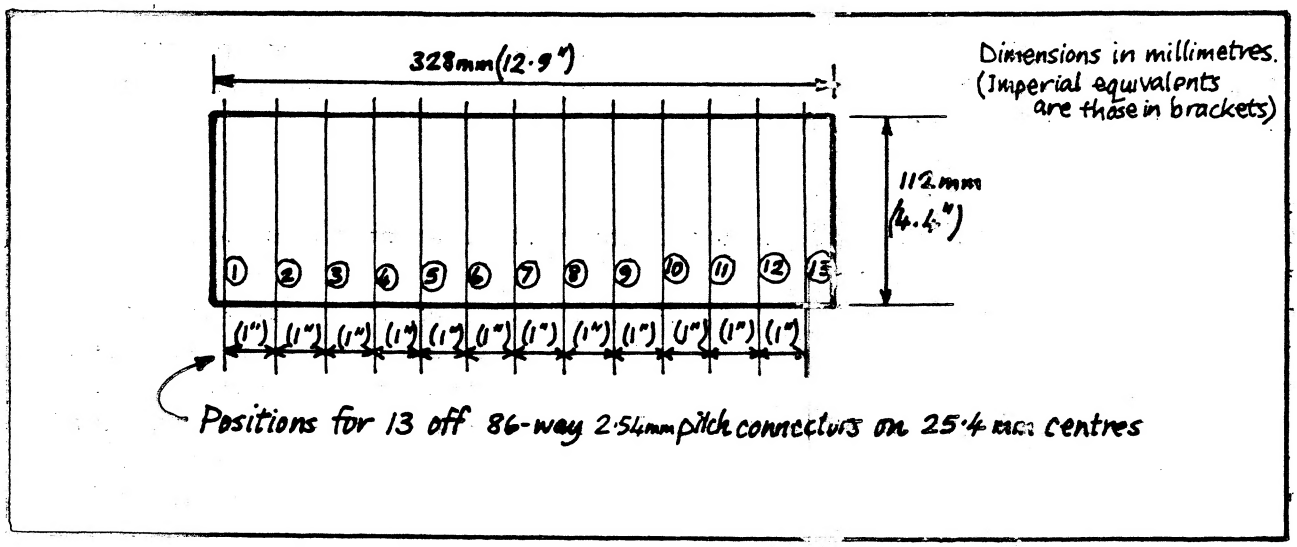
18. Singles or Doubles

If you are starting now and intend to use the printed circuit ISBUS-1.1, then you will have to decide whether to use single 43-way or double 86-way connectors. You may decide to keep your options as open as possible and choose double sided connectors even though all the present boards are single sided. Whilst this is a good idea in principle there is a slight problem in practice. Here is a cartoon which illustrates the problem.

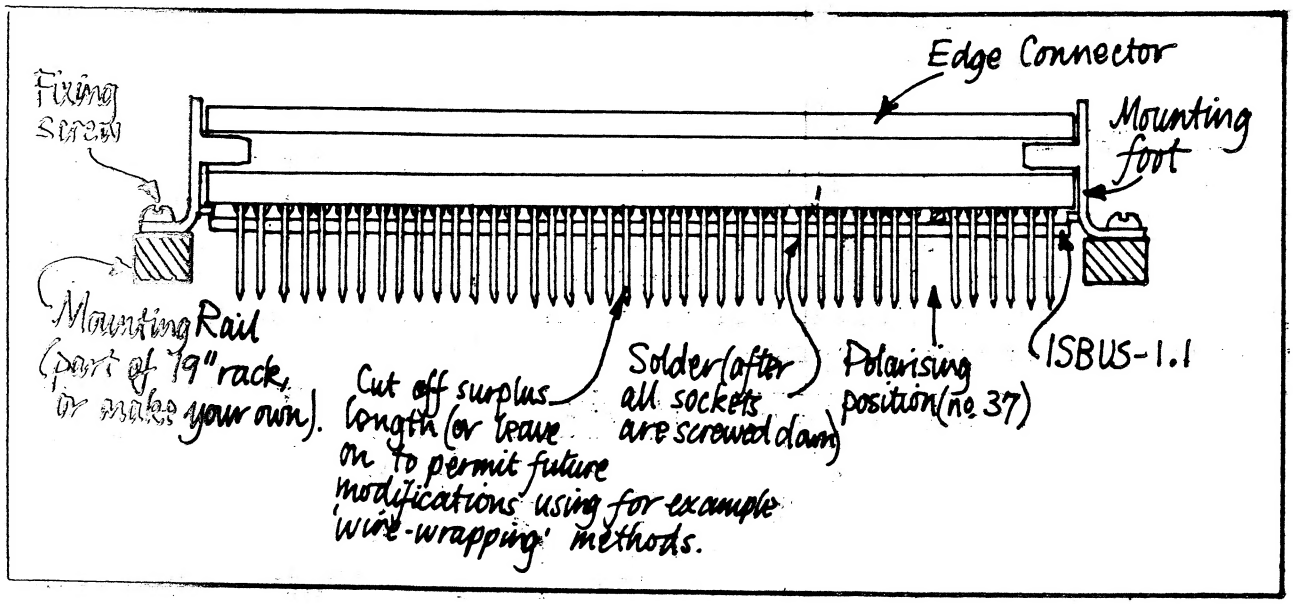

1
(Boards shown have gold-plated edge connector on one side only.)
SINGLE SIDED BOARDS NEATLY PLUGGED IN DOUBLE SOCKETS - THINGS ARE LOOKING GOOD.
2
LATER...
(Now we know why they call it the 'B' side!)
GOLD MARKS
CRIPES! THE ABRASIVE NATURE OF THE BARE FIBREGLASS HAS STARTED TO SCRAPE OFF THE GOLD FROM THE SOCKET!

(This by the way is why it is wise to provide gold edge connectors for all positions even when they're not all used on the board - except where a board is not likely to be used in another slot, e.g. power supply board).
One suggestion, which we have not tested, is to cover the bare fibreglass with a thin layer of e.g. transparent tape. Don't overdo it, because if you make the board too thick you might strain the socket, so that it is too loose to make good contact if and when you eventually do fit a board with a double sided edge connector.

19. The Long and the Short of It.

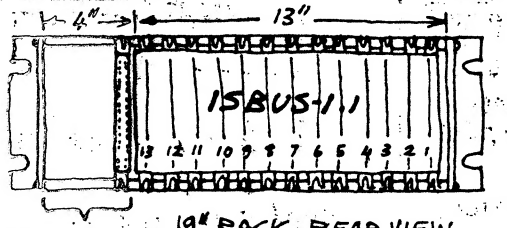

328mm(12.9")
Dimensions in millimetres.
(Imperial equivalents are those in brackets)
112mm
(4.4")
1 2 3 4 5 6 7 8 9 10 11 12 13
(1") (1") (1") (1") (1") (1") (1") (1") (1") (1") (1") (1")
Positions for 13 off 86-way 2·54mm pitch connectors on 25·4 mm centres

20. How to Do It.


Edge Connector
Fixing Screw
Mounting foot
Mounting Rail (part of 19" rack, or make your own).
Cut off surplus length (or leave on to permit future modifications using for example wire-wrapping methods.
Solder (after all sockets are screwed down)
Polarising position (no. 37)
ISBUS-1.1

21. Where To Do It

ONE WAY!




19" RACK REAR VIEW

Space for 4" module and separate edge connector (if used) for PSU e.g. 'Kemitron' PSU-A

Sockets for up to 13 identical cards (If using certain 'Kemitron' cards which cannot be made to conform to the parallel bus structure of ISBUS - e.g cards VDU-A, B, G, DCR-6 either cut off a few inches of the ISBUS itself, or lift off any offending tracks.)

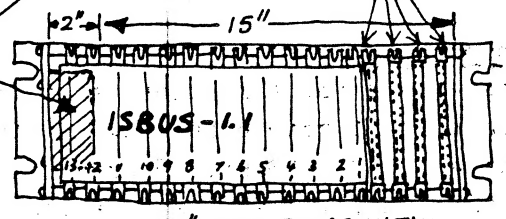
ANOTHER WAY!

If ISBUS-1.1 is mounted at the other end of the rack and alternative arrangements made for the power supply (ie 'Kemitron' PSU not fitted), the resulting 4" space near end '1' can be used for the 4 'difficult' 'Kemitron' cards VDU A, B, G and DCR-6 - or of course for any cards of your own.

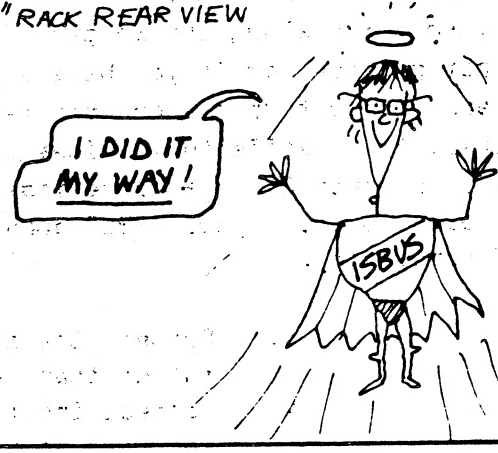
As the boxed ready made switch-mode 50 Watt power supplies we have available are only 2", it is possible to bolt one to the side of the rack in the position shown shaded - in this case positions 12 and 13 are not able to be used on the ISBUS.

Switch mode supply bolted to side of rack

Sockets for 'Kemitron' DCR-6, VDU-A, B, G (if used) mounted individually in 19" rack at this end

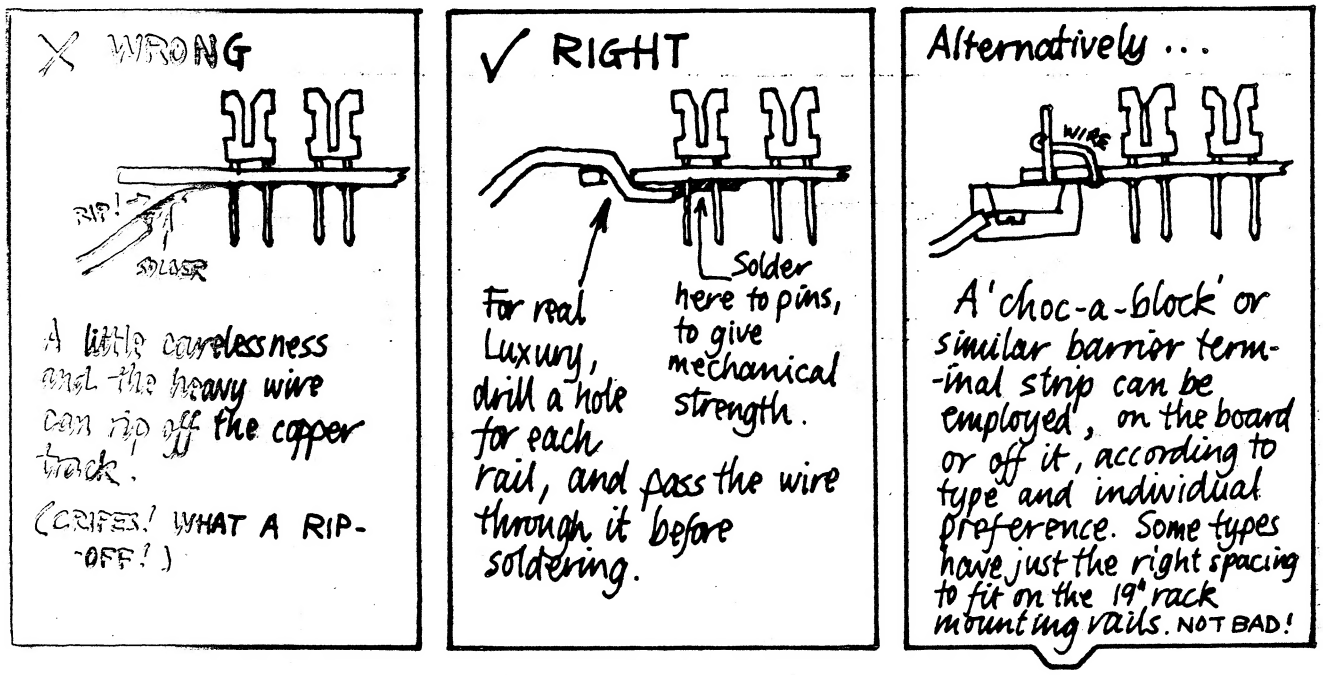



19" RACK REAR VIEW




22. ISBUS POWER

As fairly heavy wires will be used to carry power to the ISBUS take care not to solder them in a position where they can rip off the track; it is best to solder to one of the connectors to act as a terminal pin and provide mechanical strength.


X WRONG
RIP!
SOLDER
A little carelessness and the heavy wire can rip off the copper track.
(CRIPES! WHAT A RIP-OFF!)
✓ RIGHT
For real Luxury, drill a hole for each rail, and pass the wire through it before soldering.
Solder here to pins, to give mechanical strength.
Alternatively ...
WIRE
A 'choc-a-block' or similar barrier terminal strip can be employed, on the board or off it, according to type and individual preference. Some types have just the right spacing to fit on the 19" rack mounting rails. NOT BAD!

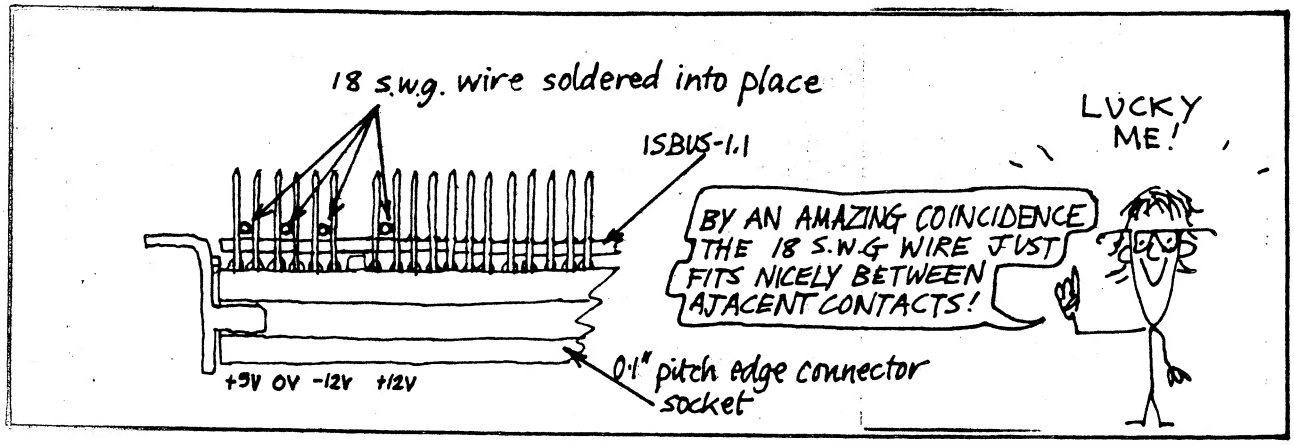
23. Muscle Man Report Here

The copper track used for the power rails can carry sufficient power for a typical system without reinforcement. (A'typical' system has a VDU, 6K ROM, Keyboard Interface, 8+2K RAM, Prom Programmer, Tape. )
The crucial thing that is necessary is that there should be no significant voltage drop along the length of the bus. If you are using the ISBUS for some other purpose, or if you have a giant power hungry system it is as well to check the volt drop along the length of the bus (the 5V and 0V rails are most likely to be afffected). Ideally this should be no more than 0.1 Volt but 0.25V or even 0.5V can sometimes be tolerated. Here are some things you can try, before you throw your ISBUS away, the suggestions are listed in increasing order of complexity.

1. Connect the input power supply to the centre, rather than one end of the bus.
2. Connect input power to both ends of the bus (as used in 13-Amp 240Vac domestic 'ring main' circuits).
3. Reinforce the bus power rails affected, using 18swg bare tinned copper wire.

It is not too difficult to implement suggestion 3, cunningly the genius who allocated the power rails arranged for two adjacent contacts for each power rail on the 'A' side, and an identical arrangement with the same numbers on the 'B' side.

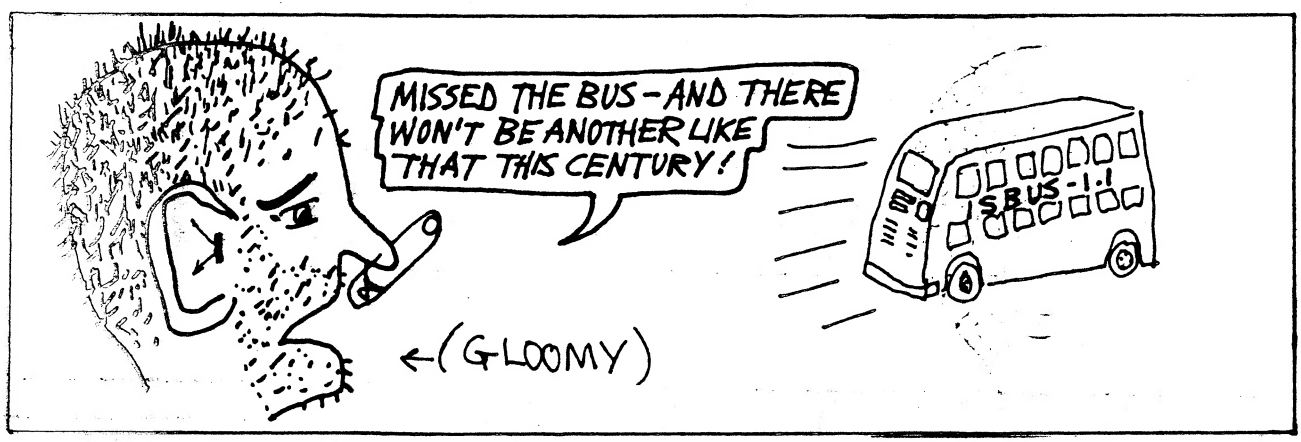
The finished result would look like this:


18 s.w.g. wire soldered into place
ISBUS-1.1
LUCKY ME!
BY AN AMAZING COINCIDENCE THE 18 S.W.G WIRE JUST FITS NICELY BETWEEN ADJACENT CONTACTS!
0.1" pitch edge connector socket
+5V 0V -12V +12V

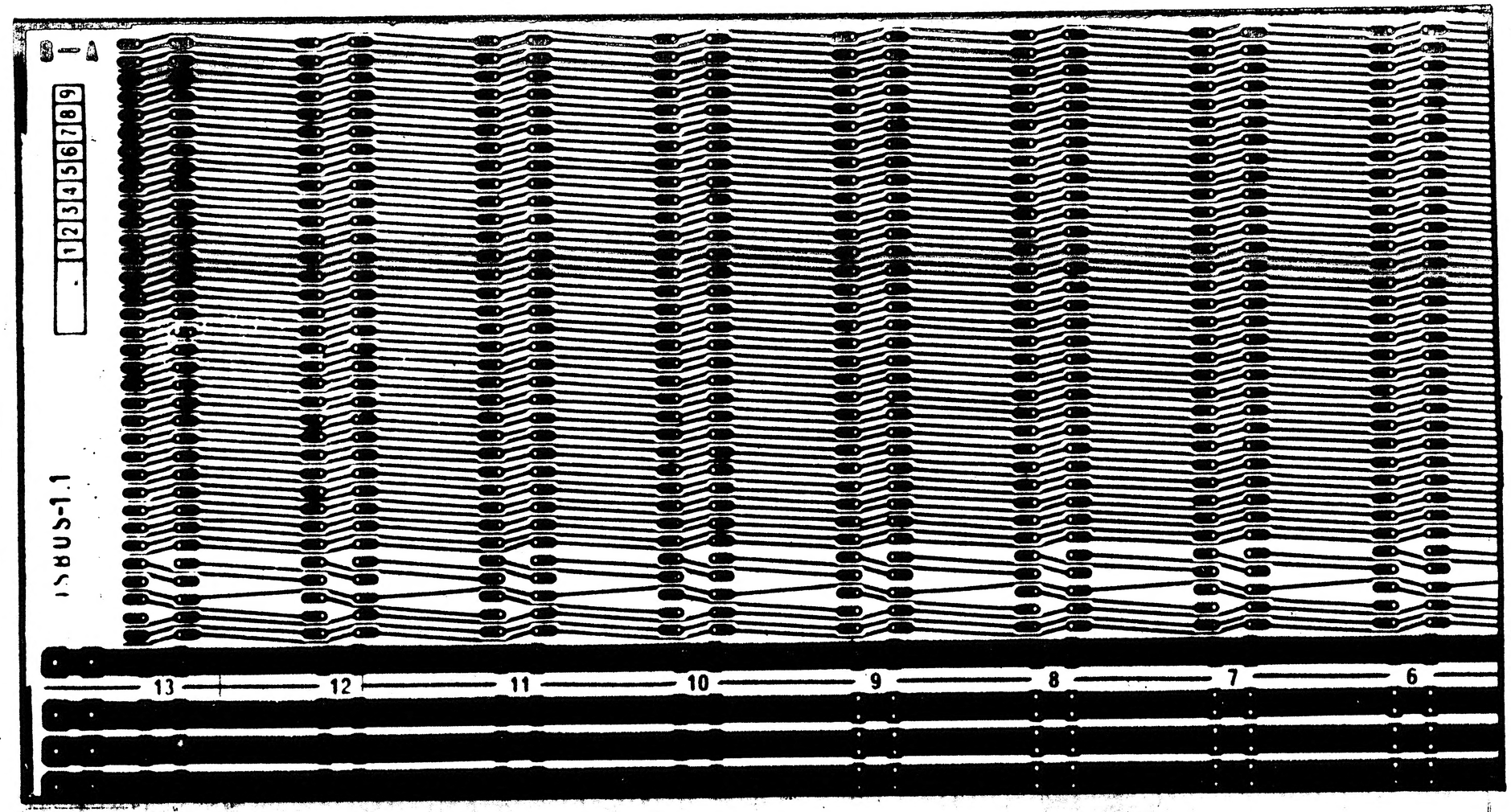
Typical systems draw much higher currents from the 5V rail than from either + or -12V rails, and so the + and -12V rails could have been made much thinner. As it happens, on the standard ISBUS board all the power rails are the same width so it is possible that the reinforcing of the bus to deal with high currents, as illustrated above, would in fact only be necessary on the 5V power rail and 0V power rail. It would only be necessary to consider the + and -12V rails if high currents of a few amps or more were likely in a given system.

On the following page we will try and reproduce an illustration of a small section of the master for the ISBUS. However, as we are much better at designing computers than we are at printing (which you may find hard to believe), we do not have much confidence that it will turn out, so it would be much better if you were to

BUY ONE TODAY!



1 OF 1




Only part of board is shown - full board accommodates up to 13 sockets on 1" centres.

| | | | |
|---|---|---|---|
| | | DMP. 30.5.80 | GREENBANK ELECTRONICS |
| | | SCALE 1:1 | ISBUS 1.1 PARTIAL ILLUSTRATION |
| | | | 1 OF 1 |

Appendix 1.

Brief notes regarding the suitability of various 'Kemitron' cards in an 'ISBUS' system.
All of the 'Kemitron' computer cards produced so far have an edge connector area on only the 'A' side, and therefore strictly speaking none are compatible for use on the 'ISBUS' which specifies the 'B' side as well.
However, as the more important connections have been arranged to be on the 'A' side many of the 'Kemitron' cards can be used to advantage. The list below and our comments may be of some assistance:

VDU A,B,G (3 card VDU set) Not directly compatible. The VDU-G has 26 pins (2,4,9-20,22-29,40-43) which are the same as for ISBUS, the others being used for an external 4k 'page select' signal ( usually from the DCR-6 card), and the remainder for interconnections to VDU A and VDU B.

DCR-6 (Keyboard Interface). This is largely ISBUS compatible. The incompatible lines are as follows :

1. Pin 2 (NADS), this is only needed when the SC/MP Protoboard is in use and so in most applications pin 2 may be redesignated.

2. Pin 30-36 (4k Page Select Outputs) - There is only one card which actually needs a 4k page select line, as all the other Kemitron cards have their own on-board address decoding components, and this the VDUG, already mentioned. This one connection could be made by other means and pins 30-36 isolated from the edge connector so that the board would run on ISBUS.

SC/MP Protoboard (2708) The board can be made ISBUS compatible if an on-board 4 bit latch is fitted to convert from a 12-bit to 16-bit address bus. Also Pin 5 (NADS) has to be modified to its new function. Pins 31 to 34 are flag and sense lines and so they must be isolated.

MPA7 (Buffered SC/MP CPU). This can be made ISBUS compatible simply by omitting IC7, which renders pins 31-35 (which were flag and sense lines), open circuit.

MZ1 (Buffered Z80 CPU), This is already ISBUS compatible.

PRM-2 (5204 PROMs) Compatible.

PRM-8 (2708 PROMs) Compatible.

MXA-1 (2101 RAMs) Compatible.

MXA-3 (2114 RAMs) Compatible.

TPA-2 (Tape Interface) This does not utilise the address and data busses and only the 5V,0V power supply pins (40-43) are the same as the ISBUS lines.

Other connections to other pins would have to be removed to obtain compatibility i.e. pins 1,2,4,30,32,34,36.

PSUA,B,C (Power Supplies) These are not compatible, and should stand alone, away from the ISBUS.

PP2 (Prom Programmer) If pins 32-34 (F1,F2,-50V) are not used, the board is then ISBUS compatible.

IP2 (8 Line Isolated Input Board) Compatible.

OP2 (8 Line Relay Output Board) Compatible.

SIO (RS232 Serial Interface) Compatible.

MZB (Replaces MZ1 Z80 board) This is compatible except for NWAIT which has to be moved from pin 30 to 34.

MXD-2 (New 16K Dynamic RAM Board) Compatible.

IMPORTANT NOTE The term'compatible' in the above paragraphs simply means that the board can be made to run with the modifications described. Some lines (notably flag lines, and page select) will have to be taken by another route if they are needed, and are no longer allowed on the bus, also some new lines e.g. NRST, NENIN, NENOUT etc., will have to be added if they are needed to suit the bus.